# EVALUATION OF METAL NUTRIENT FROM SEWAGE SLUDGE ON GROWTH OF MEDICINAL HERBS

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*To my beloved family members who show 100% support for everything that I have done for the completion of this project.*

*Thanks for all your love, patience and guidance!*

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## ABSTRACT

Generally municipal sewage sludge can be used as fertiliser as it contains a lot of nutrients. However the level of each particular nutrient has not yet been established locally. By focusing on copper (Cu), iron (Fe), manganese (Mn) and zinc (Zn) contents in municipal sewage sludge from primary oxidation pond of Taman Sri Pulai, Johor and in plant tissue sections, this study attempts to explain the relationship between plant yield and metal concentrations and suggest alternative evaluation for future in-depth studies. Raw sludge samples were collected, then air dried and ground to powder form in the beginning of a field work. The metal concentrations of sewage sludge were copper 6.9 mg/kg; iron 330.2 mg/kg; manganese 6.7 mg/kg; and zinc 9.1 mg/kg. *Curcuma longa* (turmeric) and *Orthosiphon stamineus* (cat's whiskers) were selected and the plants received different quantity of sludge application ranging from 1 g per plant to 4 g per plant weekly for six consecutive weeks while observations were done for eleven weeks inclusive of the first six weeks of sludge application and five weeks of post application period. The field experiments spanning 12 rows of vegetation and 65 pH grid points were carried out on iron rich soil. Physical parameters such as leaf length, plant height, rhizome yield, shrub width and shrub height were monitored parameters used to determine plant growth together with the chemical contents of both types of plants. All samples were acid digested using EPA Method 3050B and analysed using HACH DR5000 spectrophotometer. Soil pH readings during and after sewage sludge surface application at plant base section throughout the entire experiment did not display any statistically significant changes using one way ANOVA at $\alpha=0.05$. Turmeric displayed 99% confidence level of negative correlation in the iron-manganese interaction in the plant using one way ANOVA at $\alpha=0.01$ while cat's whiskers displayed no definite pattern of metal relationships within the shrubs. Metal ratios between copper, iron, manganese and zinc were analysed to determine the occurrence of potential metal induced stress. Cu:Mn, Fe:Mn, Cu:Zn, Fe:Zn and Mn:Zn ratios suggested that turmeric suffered from manganese and zinc deficiency under high iron environment while Fe:Mn, Cu:Mn and Mn:Zn ratios suggested that cat's whiskers suffered from manganese deficiency only. Through this study, the determined optimum sewage sludge dosage for turmeric was 3 g per plant while the optimum dosage for cat's whiskers was between 2 to 3 g per plant.

# ABSTRAK

Secara amnya, enapcemar kumbahan boleh digunakan sebagai baja kerana ia mengandungi banyak bahan nutrien. Namun kandungan setiap nutrien masih belum dikenalpasti secara terperinci. Dengan memberi fokus kepada kandungan kuprum (Cu), ferum (Fe), mangan (Mn) dan zink (Zn) dalam enapcemar kumbahan dari Taman Sri Pulai, Johor dan juga dalam komponen-komponen tisu tumbuhan, kajian ini cuba mengaitkan hubungan antara tumbesaran tumbuhan dengan kandungan logam dan mencadangkan kaedah alternatif untuk kajian yang selanjutnya. Sampel enapcemar dikutip secara mentah, kemudian dikeringkan secara udara dan dikisar menjadi serbuk halus sebelum digunakan dalam kajian. Kandungan logam dalam enapcemar adalah seperti berikut: kuprum 6.9 mg/kg; ferum 330.2 mg/kg; mangan 6.7 mg/kg dan zink 9.1 mg/kg. *Curcuma longa* yang dikenali sebagai pokok kunyit dan *Orthosiphon stamineus* yang dikenali sebagai pokok misai kucing, telah dipilih sebagai subjek dalam kajian ini diberi dos aplikasi enapcemar kumbahan yang berlainan bermula daripada 1 g per tumbuhan kepada 4 g per tumbuhan untuk enam minggu yang pertama berturut-turut manakala pemerhatian dilakukan sepanjang sebelas minggu, termasuk enam minggu dengan aplikasi enapcemar dan lima minggu lagi yang tidak diberi sebarangan nutrien. Eksperimen yang merangkumi 12 batas dan 65 titik grid pH ini dijalankan pada tanah yang mengandungi kandungan ferum yang tinggi. Tumbesaran diukur dalam parameter seperti kepanjangan daun, ketinggian tumbuhan, berat rizom, kelebaran dan ketinggian semak selain mendapatkan kandungan kimia dalam tumbuhan. Semua sampel dalam kajian ini dicerna menggunakan asid mengikut kaedah EPA 3050B sebelum dianalisis dengan menggunakan spektrofotometer HACH DR5000. Dalam eksperimen ini, nilai pH tanah didapati tidak berubah secara ketara semasa dan selepas tempoh aplikasi enapcemar pada permukaan tanah di sekeliling batang tumbuhan melalui ANOVA pada $\alpha$=0.05. Interaksi ferum-mangan dalam kunyit didapati menepati 99% korelasi negatif melalui ANOVA pada $\alpha$=0.01 manakala tiada terdapat corak yang tetap dalam interaksi logam pada misai kucing. Nisbah logam antara kuprum, ferum, manganum dan zink dianalisis untuk mengesan tekanan yang disebabkan oleh logam-logam tertentu pada tumbuhan. Nisbah-nisbah Cu:Mn, Fe:Mn, Cu:Zn, Fe:Zn dan Mn:Zn mencadangkan bahawa kunyit mengalami kekurangan mangan dan zink dalam keadaan persekitaran yang kaya dengan ferum manakala nisbah-nisbah Fe:Mn, Cu:Mn dan Mn:Zn mencadangkan bahawa misai kucing mengalami kekurangan mangan sahaja. Secara keseluruhan, kandungan optimum enapcemar bagi kunyit adalah 3 g per tumbuhan manakala kandungan optimum enapcemar bagi misai kucing adalah antara 2 hingga 3 g per tumbuhan.